NFRC Glazing U-factors and Solar Heat Gain Coefficient (SHGC)

September 1998

Since April 1994, the Washington State Energy Code has required that:

"U-factors for glazing and doors shall be determined, certified and labeled in accordance with Standard RS-31 [now NFRC 100-97] by a certified independent agency licensed by the National Fenestration Rating Council (NFRC)."

NFRC is a non-profit public/private collaboration of manufacturers, builders, designers, specifiers, code officials, consumers, utilities and regulators that has established a national energy performance rating system for fenestration products sanctioned by the federal government under the National Energy Policy Act of 1992.

NFRC has established a rigorous process by which products are rated. This rating system provides a fair, common basis for comparing product performance. By certifying and labeling their products, manufacturers are demonstrating their commitment to providing accurate energy performance information.

The NFRC rating system is referenced in the Model Energy Code and the International Energy Conservation Code. The NFRC rating system is also used as the basis for the Energy Star program for fenestration products.

NFRC publishes a *Certified Products Directory* at least annually to provide consumers, builders, utilities, manufacturers, and government agencies with accurate energy performance ratings for fenestration products such as windows, doors and skylights. The December 1997 *Directory* contains information and U-factor ratings for over 38,000 certified products. It is important to note that *only products bearing an NFRC label may be considered certified.* Products not bearing an NFRC label are not certified.

To obtain a copy of the *Certified Products Directory* ($30 for the December 1997 edition), contact NFRC at:

NFRC, 1300 Spring Street, Suite 500
Silver Springs, Maryland 20910
Telephone: 301-589-NFRC (6372)
Fax: 301-588-0854
Website: www.nfrc.org

Whole Product Performance

NFRC ratings are based on "whole product performance." Although a window or skylight may have high performance glazing, its overall performance may be reduced by a poorly performing frame. Similarly, a very energy-efficient frame may be wasted on ineffective glazing or sealing technology. By basing energy ratings on whole product performance, NFRC helps builders and consumers compare products of different construction and attributes directly.

Energy code compliance must be demonstrated on an overall product basis. Glass U-factor is not acceptable.

Basic Performance Parameters

By understanding just a few basic parameters of fenestration energy performance, product comparison can be made more easily. For the heating season, the key rating parameter is the U-factor.

U-Factor (Thermal Transmission)

The amount of heat transfer that results from a temperature difference across the window. U-factors for windows typically range from 1.15 to 0.15 (U-factors for garden windows which project out from the surface of the wall may be twice as high because the surface area is roughly double the rough-opening area in the wall. U-factors for skylights may be also twice as high due to the additional heat loss through the curb.) The smaller the U-factor, the less heat transfer between the inside and outside due to a temperature difference. For example, a window with U-factor of 0.30 will lose one half the amount of energy as a window with U-factor of 0.60 under the same conditions.

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Because the temperature difference is greater between inside and outside in the winter, U-factor particularly important during the heating season.

NFRC has also established rating procedures for Solar Heat Gain Coefficient (SHGC), important during the cooling season, and for visible light transmittance (important for daylighting), and air infiltration. The Energy Code sets maximum requirements for SHGC for nonresidential spaces (other than Group R occupancy.) For good daylight with the least heat, choose a fenestration product where the visible light transmittance is greater than the SHGC.

Innovation

The innovation that has occurred in the fenestration industry over the past ten years is astonishing. As a result of fenestration energy performance improvements over the last decade, more builders and consumers are demanding energy efficient products. Glazing systems incorporating one or more low-emissivity coatings or other thermal performance enhancements have become more common. Government and private sector research continues to expand energy efficiency technologies. Some technological innovations that are appearing in today's fenestration products include:

- **Low emissivity coatings and films:** Materials and films designed to reflect radiation of specific wavelengths. These can be designed to reflect heat back into a room in winter or to reflect unwanted summer solar heat gain;
- **Inert gas fills:** Suppresses convection and conduction through the air space in multiple-glazed units;
- **Low conductivity spacers:** "warm edge technologies" which improve the edge of glass performance; and
- **Advanced frame materials:** frame technologies utilizing composites or low-conductivity elements designed to improve energy performance.

How the Rating System Works

NFRC 100-97 uses a combination of state-of-the-art computer simulations and improved thermal testing to determine whole product energy performance. Manufacturers seeking to acquire energy performance ratings for their products contact NFRC-accredited simulation laboratories. These simulation laboratories, listed in the *Certified Products Directory*, use advanced computer tools to determine product performance ratings. To become accredited, each laboratory must demonstrate competence in the use of the computer programs used in the rating system and must meet strict independence criteria.

Following computer simulation, one of the most energy-efficient products within each product line undergoes thermal testing to validate the computer simulations. This testing is performed at an NFRC-accredited testing laboratory. These laboratories have demonstrated their ability to conduct NFRC thermal tests, are periodically inspected and evaluated by the NFRC for continued competence, and are independent from any product manufacturer they serve. A list of current NFRC-accredited thermal testing laboratories is included in the *Certified Products Directory*. Generally, if the test results are within 10% of the simulated values, then the simulated U-factors are considered validated and manufacturers have product ratings for that entire product line. (This is different from previous Energy Code requirements which were based on testing, and where every product needed to be tested.)

Performance Certification and Labeling

NFRC has a series of checks and balances to ensure that the rating system is accurately and uniformly employed. Products and their ratings may be certified by an NFRC-licensed Independent Certification and Inspection Agency (IA). To certify performance, the IA reviews all simulation and test information, conducts in-plant inspections, and provides secondary oversight to the manufacturer's in-house quality control program.

Performance certification helps ensure that:

- rated products reaching the marketplace are built in the same manner as the product samples simulated and tested;
- appropriate product ratings and labels are put on the correct product; and
- the manufacturer maintains an in-house quality assurance program to support accurate and consistent energy performance ratings for its products.

Licensed IAs must demonstrate their ability to perform these services and meet strict independence criteria.

Unlabeled Glazing

While the energy code is based on NFRC U-factors, there are a limited number of defaults available for un-

labeled products. These defaults tend to reflect worst-case performance. Consequently, NFRC U-factors are the preferred method for showing compliance.

Information to be Included on the Plans

The plans must contain a glazing and opaque door schedule (see next page for example) which contains:

- The glazing schedule must include vertical and overhead glazing (windows, sliding and swinging glass doors, glass block, skylights, etc.)
- The glazing and opaque door schedules must include the product type, size, number of each type, the U-factor, and whether the U-factor is NFRC-certified or default. (If a default is used, the schedule must include a description of the key energy-efficiency features that are necessary to achieve that default U-factor.)
- The glazing schedule must include the manufacturer and model number for all products with a U-factor less than 0.40. (This includes prescriptive options V, VI, VII, and VIII in Table 6-1 and option VIII in Table 6-2. It also may include Target UA and annual energy analysis compliance options.)
- For nonresidential projects, the glazing schedule must also include the solar heat gain coefficient (SHGC) for each product.

Further Information

For projects within the Seattle city limits, further information on Seattle Energy Code requirements is available from the DPD Technical Support Line at (206) 684-7846 from 1:00 p.m.to 4:15 p.m., or visit the Energy Code website at www.seattle.gov/dpd/energy.

Access to Information

Links to electronic versions of DPD **Client Assistance Memos (CAMs), codes,** and **forms** are available on the "Publications" and "Codes" pages of our website at **www.seattle.gov/dpd**. Paper copies of these documents are available from our Public Resource Center, located on the 20th floor of Seattle Municipal Tower at 700 Fifth Ave. in downtown Seattle, (206) 684-8467.

(Sample)

GLAZING AND OPAQUE DOOR SCHEDULE

GLAZING (VERTICAL)

Glazing Number	Plan Page	Manufacturer/Model No. and Special Features	Product Type	Size (W x H)	Area (Sq. Ft.)		No.		Total (VGA)	U-Factor NFRC-certified	U-Factor Default	VGA x U =
SLW-1	A-3,4	Best Energy/123 w/low-E & argon	slid. win.	3'0" x 5'0"	15.0	x	4	=	60.0	0.33	--	19.8
SLW-2	A-3,4	Best Energy/123 w/low-E & argon	slid. win.	4'0" x 6'0"	24.0	x	2	=	48.0	0.33	--	15.8
PIC-1	A-3	Best Energy/153 w/low-E & argon	fixed win.	5'0" x 5'0"	25.0	x	2	=	50.0	0.31	--	15.5
GAR-1	A-3	Greenhouse/vinyl/dbl/low-E/argon	garden win.	3'0" x 4'0"	12.0	x	1	=	12.0	--	1.47	17.6
SLD-1	A-3,4	Best Energy/203 w/low-E & argon	slid. door	6'0" x 6'8"	40.0	x	1	=	40.0	0.36	--	14.4
								Total VGA =	**210.0**	**Total VGA x U =**		**83.1**
										Area-Weighted Average Vertical Glazing U-Factor = (Total VGA x U) / (Total VGA) =		**0.396**

GLAZING (OVERHEAD)

Glazing Number	Plan Page	Manufacturer/Model No. and Special Features	Product Type	Size (W x H)	Area (Sq. Ft.)		No.		Total (OGA)	U-Factor NFRC-certified	U-Factor Default	OGA x U =
SKY-1	A-5	Sky Systems/57 triple w/low-E	skylight	2'0" x 4'0"	8.0	x	2	=	16.0	0.52	--	8.32
SKY-2	A-5	Alum. clad vinyl/triple dome	skylight	2'0" x 2'0"	4.0	x	2	=	8.0	--	0.67	5.36
								Total OGA =	**24.0**	**Total OGA x U =**		**13.68**
										Area-Weighted Average Overhead Glazing U-Factor = (Total OGA x U) / (Total OGA) =		**0.570**

OPAQUE DOOR

Number	Plan Page	Manufacturer/Model No. and Special Features	Product Type	Size (W x H)	Area (Sq. Ft.)		No.		Total (TDA)	U-Factor NFRC-certified	U-Factor Default	TDA x U =
INS-1	A-3	Insuldoor/VIZ insulated metal w/tb	swing. door	2'8" x 6'8"	17.8	x	2	=	35.6	0.09	--	3.2
WD-1	A-3	Woodland/26 1-3/4 wood w/1-1/8 panels	swing. door	3'0" x 6'8"	20.0	x	1	=	20.0	--	0.39	7.8
								Total TDA =	**55.6**	**Total TDA x U =**		**11.0**
										Area-Weighted Average Opaque Door U-Factor = (Total TDA x U) / (Total TDA) =		**0.198**